JOINT ASSEMBLY FOR A TRIM PANEL

FIELD OF THE INVENTION

This invention generally relates to motor vehicle trim panels having multiple cover portions and a method for joining the multiple cover portions. Motor vehicle trim panels may be comprised of multiple colors, materials, textures and the like. More particularly, the invention relates to an apparatus and method for forming a joint line having a pleasing appearance between these multiple cover portions.

BACKGROUND OF THE INVENTION

It is well known to provide trim panels to cover the interior surfaces of motor vehicles, as well as other modes of transportation, to enclose sharp edges, improve aesthetics and reduce outside noise. Early on, these trim panels were metal or hard plastic components, but as vehicle interiors became more friendly, comfortable and luxurious, softer materials and combinations of leather, cloth, textiles, plastic skins with foam backing and injection molded plastics became the norm. These softer, and often padded, trim panels are generally mounted in a vertical orientation around the inner walls of the vehicle body forming the passenger compartment. To further improve the aesthetics of vehicle interiors, it is preferred to minimize the number of joint lines or opportunities for uneven unsightly gaps that may be present. Dimensional registration of adjoining trim panels is often problematic as these panels must be mounted such that their class A surfaces are flush in the vehicle and any gaps between the panels are narrow and uniform. Thus, fewer larger panels rather than multiple smaller trim panels are used, however the larger panels must meet a wider combination of environmental and use requirements. This has led to the creation of a "belt line" or midpoint vertically on the panels which distinguishes the need for the panel to have certain properties on their upper surface nearer the vehicle windows than closer to the floor. The upper surfaces of these vertical trim panels are generally lighter in color and softer than the surfaces which are below the midpoint or belt line and which are more likely to be soiled, scuffed or kicked. In addition, the upper surfaces undergo more sunlight exposure through the glass of the vehicle (greenhouse effect) which requires that they be made from more expensive weather-resistant materials.

This has led to the need to provide vehicle trim panels which combine multiple colors, multiple textures and multiple materials into a single larger trim component. Finishing the joint line between these multiple materials has remained problematic, especially when a smooth and aesthetically pleasing "class A" finish is desired. To improve the aesthetic appearance of such trim panels, it is desired to create the appearance of a smooth flowing joint line with accurate dimensional registration in all three axes so that non-uniform gaps to adjacent panels are not created.

SUMMARY OF THE INVENTION

A joint for a trim panel comprising a first outer cover having an inner surface, an outer surface and a connector portion formed therein, a second outer cover having an inner surface, an outer surface and a connector portion formed therein, a connector platform having a first connector portion and a second connector portion, the first connector portion connected to the first outer cover connector portion and the second connector portion connected to the second outer cover connector portion.

A joint for a trim panel comprising a first outer cover having an inner surface, an outer surface, a joint line edge and a connector portion formed therein, the connector portion comprising a plurality of receptacles disposed along the first outer cover joint line edge, the receptacles comprising through holes, a second outer cover having an inner surface, an outer surface, a joint line edge and a connector portion formed therein, the connector portion comprising a plurality of receptacles disposed along the second outer cover joint line edge, the receptacles comprising through holes. A connector platform is supplied having a first connector portion and a second connector portion, the first connector portion comprising a plurality of protrusions and the second connector portion comprising a plurality of protrusions, wherein the protrusions of the first connector portion of the connector platform extend into the receptacles of the first outer cover to form a connection between the connector platform first connector portion and the first outer cover connector portion. The protrusions of the second connector portion of the connector platform extend into the receptacles of the second outer cover to form a connection between the connector platform second connector portion and the second outer cover connector portion.

A trim panel comprising a first outer cover, a second outer cover, a connector platform, a joint comprising said first outer cover and said second outer cover connected to

said connector platform, a substrate held in spaced relationship to said first outer cover and said second outer cover, said spaced relationship comprising foam.

A trim panel comprising a first outer cover, a second outer cover, a connector platform, a joint comprising said first outer cover and said second outer cover connected to said connector platform, a substrate formed directly behind said first outer cover and said second outer cover, comprising a reaction injection molded plastic composition.

A method for forming a joint for a trim panel comprising, providing a first outer cover having an inner surface, an outer surface and a connector portion formed therein, providing a second outer cover having an inner surface, an outer surface and a connector portion formed therein, providing a connector platform having a first connector portion and a second connector portion, connecting the first connector portion to the first outer cover connector portion and connecting the second connector portion to the second outer cover connector portion.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the invention will become apparent upon consideration of the description of the invention and the appended drawings in which:

FIG. 1 is a representative perspective view of a trim panel according to the present invention;

FIG. 2 is a partial cross-sectional view of FIG. 1 taken along line 2-2;

FIG. 3 is a plan view of the outer cover portions and connector prior to assembly;

FIG. 4 is a partial cross-sectional of the outer cover portions and connector after assembly; and

FIG. 5 is a partial cross sectional view of the trim panel of FIG. 1 in a foam mold prior to introducing foam material.

The above and other objects, features, and advantages of the present invention will be apparent in the following detailed description thereof when read in conjunction with the appended drawings wherein the same reference characters denote the same or similar parts throughout the several views.

DESCRIPTION OF THE INVENTION

This invention provides a trim panel assembly that includes a variety of different outer cover portions attached to, located and retained by a connector platform which forms a joint. The connector platform is positively located in a foaming mold to assure three dimensional location of the joint line. Following foaming in place to attach the outer cover portions to a substrate, the connector platform may be fitted with a joint cover to yield a finished trim panel. In accordance with this invention, a method is provided for accurately attaching and locating multiple outer cover portions to a connector platform that defines the finished trim panel joint line. The present invention assures that any combination of materials, skin, cloth, textile, molded hard plastic, etc. can be combined to form an aesthetically pleasing trim panel.

According to another aspect of the invention, the connector platform with outer cover portions attached is positively located in a foaming mold to register the outer cover portions and joint line to the substrate and trim component periphery. According to another aspect of the invention, in the final assembled condition, a joint cover is applied over the connector platform to yield the desired appearance.

An alternate preferred embodiment of the invention uses the platform connector as the final joint cover or trim bezel by inverting the assembly procedure of the platform connector to the outer cover portions. The platform connector would then extend from the outer surface of the outer cover portions through the inner surface of the outer cover portions. In this embodiment, a locating groove in the cavity of the foaming mold would correspond to the surface of the connector platform and position the outer cover portions/connector platform assembly such that a finished appearance would be obtained directly from the mold.

A further alternative preferred embodiment is provided wherein the trim panel is formed by placing the connector platform/outer cover portion assembly into the cavity of a mold and forming a substrate behind the assembly by injecting RIM urethane reinforced with glass fibers.

An exemplary automotive interior trim panel is shown in FIG. 1 at reference character **10**. As shown, interior trim panel **10** comprises a door trim panel. Other examples of trim panels **10** include, but are not limited to, an instrument panel, a headliner, a quarter panel, a console, a door panel and a package shelf.

As shown in FIG. 2, the trim panel **10** comprises a flexible outer cover **12**, a substrate **14** and an intermediate foam layer **16** disposed there between. Preferably substrate **14** is configured to attach or otherwise retain, either directly or indirectly (e.g. with fasteners), the trim panel **10** to another member of the vehicle, such as the vehicle body, and is sufficiently rigid to maintain the shape of the trim panel **10** and to be self-supporting upon installation and with use in the vehicle.

As best shown in FIG. 3, outer cover **12** comprises at least two outer cover portions, first outer cover portion **18** and second outer cover portion **20**. The outer surfaces **62, 64** of outer cover portions **18, 20** are generally the aesthetic surfaces viewed by a vehicle occupant. With regards to cover materials, outer cover portions **18, 20** may comprise thermoset or thermoplastic polymers. Examples include, but are not limited to, polyacetal, polyamide, polyurethane, acrylonitrile-butadiene-styrene, polyethylene, polypropylene, polyester, polystryene, thermoplastic olefins, thermoplastic elastomers, polyvinyl chloride, and polyphenylene oxide. Outer cover portions **18, 20** are preferably formed by a plastic forming process such as, but not limited to, spray coating, casting, rotational molding, slush molding, blow molding, vacuum forming, and thermo-forming.

Outer cover portion **18** and outer cover portion **20** may also comprise different colors, grain patterns, thicknesses, and/or materials. Examples of different materials include but are not limited to, cloth, leather, plastic skins, textiles, pile and the like. One outer cover portion may be softer or harder relative to the other, or one outer cover portion may comprise a continuous sheet or film while the other comprises a textile, depending on the type of vehicle and the conditions of use of that portion of the trim panel (scuff, wear, exposure to light, contact with a vehicle occupant).

Each outer cover portion **18, 20** preferably comprises a plurality of receptacles **22, 24**, respectively. As shown, receptacles **22, 24** comprise through-holes. As shown in FIG. 3, receptacles **22, 24** are disposed adjacent and along opposing contoured joint line edges **26, 28** of outer cover portions **18, 20**. Also as shown in FIG. 1, opposing joint line edges **26, 28** extend across the face **30** of trim panel **10**. As shown in FIG. 4, receptacles **22, 24** are preferably formed perpendicular to the cross-sectional thickness **32, 34** of outer cover portions **18, 20**, respectively.

Also as shown in FIG. 4, a joint assembly **8** is formed from outer cover portions **18, 20** when are each joined to a connector platform **36**. Connector platform **36** preferably comprises a plastic material and, more preferably, a thermoplastic. Examples of

thermoplastic include, but are not limited to, polyacetal, polyamide, polyurethane, polycarbonate, acrylonitrile-butadiene-styrene, polycarbonate-acrylonitrile-butadiene-styrene, polyethylene, polypropylene, polyester, polystryene, thermoplastic olefins, thermoplastic elastomers and polyphenylene oxide. Connector platform **36** is preferably formed by a plastic forming process such as, but not limited to, injection molding or extrusion, but could also comprise a formed metal strip or a combination of formed metal and plastic.

As shown in FIGS. 3 and 4, connector platform **36** comprises a plurality of protrusions **38, 40** and extends along the face **30** of trim panel **10**. Also as shown, the pattern of the protrusions **38, 40** on the connector platform **36** extending across the face **30** of the trim panel **10** coincides with the pattern of receptacles **22, 24** located on outer cover portions **18, 20**.

In the above manner, as shown in FIG. 4, protrusions **38, 40** mechanically engage the receptacles **22, 24** of outer cover portions **18, 20** when the protrusions **38, 40** extend into the receptacles **22, 24**. As shown, protrusions **38, 40** preferably comprise a locator device in the form of a post having a constant diameter down its length from top to bottom. In other words, in functioning as a locator device, protrusions **38, 40** orientate the outer cover portions **18, 20** relative to the connector platform **36** and connect outer cover portion **18** to outer cover portion **20** across the face **30** of the trim panel **10**. As such, protrusions **38, 40** typically have a diameter from 0.0001" to 0.04"smaller than the diameter of the receptacles **22, 24** and, more preferably, a diameter from 0.001" to 0.01" smaller than the diameter of the receptacles **22, 24**.

After protusions **38, 40** extend into the receptacles **22, 24**, preferably inner surfaces **42, 44** of outer cover portions **18, 20** make contact with the outer surfaces **46, 48** of the connector flange portions **50, 52** from which protrusions **38, 40** extend. More preferably, inner surfaces **42, 44** of outer cover portions **18, 20** are bonded to the outer surfaces **46, 48** of the connector flange portions **50, 52**, and even more preferably, are autogenicly bonded. In other words, bonded where the bonding substance comprises the material of the outer cover portions **18, 20** and/or the connector platform **36** themselves, as opposed to the use of separate materials such as adhesives.

In order to achieve autogenic bonding of the inner surfaces **42, 44** with the outer surfaces **46, 48**, preferably an interface (i.e. contact location) between the two materials is subjected to heat and pressure. By application of heat and pressure to the cover portions **18, 20** and/or the connector platform **36**, at least the surface portion of the cover and/or connector

subjected to the heat softens and/or melts to give it adhesive properties. Typically, a thin layer of melt on at least one of the plastic surfaces to be joined is created, at which time the cover portions **18, 20** and the connector platform **36** may be pressed together. This melt is subsequently cooled and bonds the surfaces, at which time the clamping force is removed.

The above description may be more appropriately characterized as thermal autogenic bonding. In other words, autogenic bonding is achieved by the application of heat to at least one of the items to be bonded. Furthermore, the temperature at which thermal autogenic bonding occurs may be referred to as the "thermal autogenic bonding temperature".

Autogenic bonding may also be performed without heat, for example, by means of a suitable solvent applied to the item(s) to be bonded which "softens" the bonding surface. Adhesion is attained by evaporation of the solvent, absorption of it into adjacent material, and/or diffusion of liquefied polymer molecules or chain segments across the interface.

While autogenic bonding as described above is the preferred bonding method, it should be understood that bonding of the inner surfaces **42, 44** with the outer surfaces **46, 48** may be accomplished by any method known in the art, autogenic or not, such as, but not limited to, vibration welding, ultrasonic welding, high-frequency welding, electromagnetic welding, induction welding, friction welding, hot-gas welding, hot-plate welding, heat staking, adhesive bonding, or mechanical fastening.

Once the outer cover portions **18, 20** are joined to the connector platform **36**, in the preferred method of manufacturing trim panel **10**, they are next placed in a mold cavity **54** of a mold assembly **56**. In other words, a mold assembly **56** which comprises a first mold half **58** on the front side of the part to be formed and a second mold half **60** on the opposing side of the part to be formed, generally referred to as the female and male mold halves. As shown in FIG. 5, the outer surfaces **62, 64** of outer cover portions **18, 20** are placed in contact with mold surface **66** of first mold half **58** while outer surface **68** of substrate **14** is placed in contact with mold surface **70** of mold half **60**. Upon positioning of the outer cover portions and the substrate within mold cavity **54**, an open space **72** is created between the inner surfaces **42, 44** of outer skin portions **18, 20** and the inner surface **74** of substrate **14** which is eventually occupied by foam **16**.

Foam layer **16** is preferably formed by introducing a foam, or more preferably, a foam precursor material into open space **72**. Preferably, the foam precursor is a urethane foam precursor which is introduced using a reaction injection molding or low pressure foaming process as known in the art. After the urethane foam precursor is introduced, the reactive

constituents, a polyol and isocyanate, begin to react and the subsequently created foam material flows and expands to fill the open space **72**, thus bonding outer skin portions **18, 20** to substrate **14** while at the same time flowing around and preferably bonding to the exposed surfaces of connector platform **36**, thus securing all the individual components in place relative to one another. Panel substrate **14** may be of any materials known to those skilled in the art. Examples include, but are not limited to, plastic, metal, paper, woodstock, chip board and the like.

Foam layer **16**, which may be characterized as having a low density and generally flexible or semi-rigid by virtue of its cushion or padding effect, preferably exhibits the following properties per Table 1.

Table 1

Property	Test Method	Value
Density	ASTM-3574-95	0.016 - 0.288 g/cm^3
Ultimate Elongation	ASTM-3574-95	Greater than 10%

With regards to measuring density, while any suitable test method may be used, the preferred test method is that of ASTM-3574-95, Test A – Density Test. With regards to range of density values, while the preferred value identified above is from 0.016 to 0.288 g/cm^3, more preferably the value is from 0.06 to 0.15 g/cm^3. With regards to the measured value, it is noted that the above values correspond to that of any single specimen (taken from any location within the trim panel **10**), either an interior density specimen or a section density specimen as defined in ASTM-3574-95, and not the calculated median of more than one measured specimen. This is in accordance with ASTM-3574-95, paragraph 11.1 which calls for a single specimen to be tested.

With regards to measuring ultimate elongation, while any suitable test method may be used, the preferred test method is that of ASTM-3574-95, Test E – Tension Test. With regards to the range of elongation values, the preferred value identified above is greater than or equal to five percent (5%), more preferably the value is greater than or equal to ten percent (10%), and even more preferably the value is greater than or equal to twenty-five percent (25%) ultimate elongation. With regards to the measured value, it is noted that the above values correspond to that of any single specimen (taken from any location within the trim panel **14**), as defined in ASTM-3574-95, and not the calculated median of more than one measured specimen. This is in accordance with ASTM D-3574-95, paragraph 48.1 which calls for three specimens to be tested and the median value to be reported.

Alternatively, the trim panel may be preferably formed using the reaction injection molding (RIM) process to form the substrate **14** and backing layer **16** in a single step. This may be carried out by attaching the outer cover portions to the connector platform, locating that assembly in the cavity of a preferred metal mold and backfilling the mold with a glass-reinforced RIM composition to form a semi-rigid self-supporting panel. While a glass-reinforced RIM composition is preferred, compositions using other types of reinforcement or without any reinforcement may be used.

In order to properly locate connector platform **36** relative to mold assembly **56**, preferably connector platform **36** comprises a receptacle **76** which mechanically engages a protrusion **78** extending from mold surface **66** of first mold half **58** when the protrusion **78** extends into the receptacle **76**. As shown in FIG. 5, receptacle **76** preferably comprises a locator device in the form of a U-shaped recess with a constant width along its length. In other words, in functioning as a locator device, receptacle **76** orients the connector platform **36** relative to the first mold half **58** and side-to-side as well as up-down (x, y axes) relative to the substrate **14**.

More preferably, in order to orient the connector platform **36** relative to the outer surface **68** of the substrate, base portion **80** of the receptacle **76** preferably contacts against the inner surface **74** of the substrate **14** when mold assembly **56** is closed. Moreover, the outer surface **82** of the base **80** more preferably develops a seal against inner surface **74** of the substrate **14** to prevent foam **16** from extending therebetween and also to keep inner surface **82** of the base **80** parallel to the inner surface **74** of the substrate **14** to prevent the connector platform **36** from being tilted relative to the face **30** of the trim panel **10**.

As shown in FIG. 2, connector platform **36** preferably interferes with a portion of the base **84** of a U-shaped recess **86** extending across the face **30** of trim panel **10**, with the remainder of the base **84**, as well as side wall portions **88, 90** of the recess **84** comprising outer cover portions **18, 20**, respectively. In this manner, upon installation, the head portion **92** of a T-shaped joint cover **94** may be located in the recess **84** with the outer surface **96** of the joint cover **94** substantially flush (i.e. within plus or minus 1 mm) with the outer surfaces **62, 64** of outer cover portions **18, 20**.

In order to connect joint cover **94** to trim panel **10**, preferably base **80** of connector platform **36** and substrate **14** comprise one or more coinciding through-holes **98, 100** through which deformable snap tabs **102** located along the bottom surface **104** of leg **106** of joint cover **94** extend. Joint cover **94** is aligned with U-shaped recess **86** and deformable snap tabs

102 are engaged into through-holes **98, 100** such that arrow-tip snap tabs portions **108, 110** deform inwards towards one another. Once joint cover **94** is seated in recess **86**, the arrow-tip snap tab portions **108, 110** snap outward to engage and lock against the outer surface **68** of substrate **14**, the snap tab portions **108, 110** having passed through through-holes **98, 100**.

Alternatively to, or in combination with the use of snap tabs **102** discussed above, the distal end surfaces **116, 118** of protrusions **38, 40** may be bonded to the inner surfaces **120, 122** of head portion **92** of joint cover **94** to connect the joint cover **94** to the trim panel **10**. Other types of fastening devices than snap tabs may also be employed, such as, metal tangs, screws and nuts, grommets and the like.

In an alternate embodiment, the present invention may be used with plastic, leather, fabric or other materials to form aesthetic trim panels having multiple textures and appearances, but without the need for a reacting polymer composition to join the substrate and skin layers together. In this embodiment, a connector platform **36** engages with trim panels or cover portions **18, 20** to locate and attach these panels to each other. If the resultant assembly **12** comprises injection molded or metal panels that are relatively rigid and self supporting, it may be attached directly to the vehicle body. When softer more flexible materials are desired for outer cover portions **18, 20**, such as thin plastic skins, textiles or laminates of thermoplastic skin and foam, the connector platform **36** may be employed to locate the cover portions **18, 20** to one another through alignment and engagement of protrusions **38, 40** with through-holes **22, 24**. The resulting assembly **12** may then be directly adhered to the surface **74** of the substrate **14** using any common adhesive compatible with the plastic, textile, leather or metal which makes up the cover portions **18, 20** and the substrate **14**.

As in the proceeding embodiment, the connector platform **36** may be inverted such that its outside surface **82** becomes the finish surface for the joint line of the panel **10** or a joint cover **94** may be connected to the connector platform **36** by engaging snap tabs **102** through-holes **98, 100** in the substrate **14**.

A further alternative embodiment may comprise a hard panel substrate **14**, the lower portion (below the belt line) of which has a finished, grained aesthetically pleasing appearance. This substrate **14** may then become lower cover **20** while the upper portion of substrate **14** may have an upper cover portion **18** and a connector platform **36** fastened or adhered to provide a soft surface thereon. In this embodiment, connector platform **36** may be attached to upper cover **18** by locating protrusion **38** in through-hole **22**. This assembly **12**

may then be aligned with and attached to the upper portion of the hard panel **14** by locating protrusion **40** in hole **24** to cover the upper portion and align with the lower hard portion **20**.

As described herein, a trim panel comprising a multitude of materials is provided through the use of a connector platform which attaches and locates cover portions of trim panels to each other. The resulting trim panel is dimensionally registered and has an aesthetically pleasing appearance. In addition, a joint for a trim panel to ensure dimensional registration and a pleasing finished appearance is provided.

Thus, in the preferred embodiment, a connector platform **36** is disclosed, the connector platform **36** in cross-section comprising a U-shaped receptacle **76** (see FIG 2) having a base portion **80** and side wall portions **112, 114**. Furthermore, the connector platform **36** further comprises flange portions **50, 52** extending perpendicularly outward from side wall portions **112, 114** and parallel to the entry to the receptacle **76**. Furthermore, the flange portions **50, 52** further comprising protrusions **38, 40** extending therefrom, the protrusions extending perpendicular to the flange portions **50, 52** and parallel to the side wall portions **112, 114** of the receptacle **76**.

An alternate embodiment of the invention uses the platform connector as the final joint cover or trim bezel by inverting the assembly procedure of the outer covers to the joint connector. The platform connector would then extend from the outer surface of the outer covers through the inner surface of the outer covers. In this embodiment, locating grooves in the cavity of the foaming mold would position the connector protrusion **38, 40** relative to the substrate and the outer surface **82** of the connector platform **36** would seal tightly against the mold cavity surface **66** to form a finished appearance directly from the mold.

The description and drawings illustratively set forth our presently preferred invention embodiments. We intend the description and drawings to describe these embodiments and not to limit the scope of the invention. It should be understood that all features of the individual embodiments can be exchanged between embodiments within the scope of this invention. Those skilled in the art will also appreciate that still other modifications and variations of the present invention are possible in light of the above teaching while remaining within the scope of the following claims. Therefore, within the scope of the claims, one may practice the invention otherwise than as the description and drawings specifically show and describe.